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MONROE ELECTRONICS, INC. 5 VERNON STREET MIDDLEPORT, NEW YORK

MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND SYSTEMS

Area Code 716
735-3721

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C 149

MODULE	S/N
353B-4C	1075
370A-2	140
384A	193
3007 A	155
3008	141
3033	109

Designed and Manufactured by:

MONROE ELECTRONICS, INC.

Middleport, New York

14105

WARRANTY

Monroe Electronics, Inc. warrants each instrument and sub-assembly manufactured by them to be free from defects in material and workmanship for a period of one year after delivery to the original purchaser.

Liability under this warranty is limited to servicing, adjusting or replacement of defective parts (other than tubes, fuses or batteries) on any instrument returned to the factory for this purpose, transportation charges prepaid.

This warranty does not apply to products subjected to unauthorized repair or modification.

Before returning an instrument to the factory for any reason, notify us of the difficulty encountered; also the model and serial number of the instrument. We will furnish you with service and shipping instructions.

MONROE ELECTRONICS, INC.
5 Vernon Street
Middleport, New York 14105

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TABLE OF CONTENTS

Specifications	Section 1
Installation	Section 2
Operation	Section 3
Theory	Section 4
Internal Adjustment Procedure	Section 5
Maintenance	Section 6
Appendix I	
Model 1007 Probe Cleaning Procedure	
Appendix II	
Installation Instructions for Gas Purge Kit	
Appendix III	
Operation Instructions for Gas Purge Kit	
Model 148 Main Schematic	148/1
Model 353B-4 Operational Amplifier	353B-4/1
Model 384A ±15V Power Supply	384A/1
Model 1007 Detector/Preamplifier Probe	1007/12
Model 1007 Detector/Preamplifier Probe	1007C/22A

TABLE OF CONTENTS

Specifications Section 1

Installation Section 2

Operation Section 3

Theory Section 4

Internal Adjustment Procedure Section 5

Maintenance Section 6

Appendix I

Model 1007 Probe Cleaning Procedure

Appendix II

Installation Instructions for Gas Purge Kit

Appendix III

Operation Instructions for Gas Purge Kit

Model 148 Meta Schematic 148/1

Model 3529-4 Operational Amplifier 3529-4/1

Model 384A ±15V Power Supply 384A/1

Model 1007 Detector/Preamplifier Probe 1007/12

Model 1007 Detector/Preamplifier Probe 1007C/22A

Section 1

SPECIFICATIONS

A. MODEL 146 ISOPROBE® ELECTROSTATIC MILLIVOLTMETER/FIELDMETER

The Model 146 combines in a single instrument all the capabilities of both the Model 147 ISOPROBE® Electrostatic Millivoltmeter and the Model 148 ISOPROBE® Electrostatic Fieldmeter. Its performance specifications are identical to those of the Models 147 and 148 which follow.

The Model 146 includes a function switch which selects the desired function of voltmeter or fieldmeter.

CAUTION:

1. When used as a voltmeter, the gradient plate must be removed from the bottom of the Model 1007A probe.

2. When used as a fieldmeter, the gradient plate must be fastened to the bottom of the Model 1007A probe.

B. MODEL 147 ISOPROBE® ELECTROSTATIC MILLIVOLTMETER

Applications:

The Model 147 has been designed to function as a GENERAL PURPOSE materials research and evaluation tool. Its unique capability for reliable, NON-CONTACTING measurement of potential in the millivolt range exposes broad new areas for exploratory research as well as providing a precision instrument for existing applications in electrostatic measurement. Some typical and potential applications include:

- Contact Potential Measurements
- Electrophotographic Measurements
- Radiation Effects on Charged Surfaces
- Airborne Particle Effects on Charged Surfaces
- Non-Contacting Resistivity Measurements

Sensitivity:*

0.002 volts or better.

Input Resistance:*

Greater than 10^{17} ohms.

Input Current:*

Less than 10^{-16} amperes.

Range:

0 to ±10 volts. Meter ranges of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0 and 10 volts full scale positive or negative.

Static Accuracy:*

0.1% or better at output.

Drift:*

±0.005 volts per day non-cumulative after 12 hours warm-up.

Noise:*

Less than 0.0015 volts Rms. Less than 0.005 volts peak-to-peak.

Speed-of-Response:

Less than 50 msec, 10% to 90%.

Integrating Capacitor:

Provision for mounting an external capacitor is provided. 0.033 µf supplied internally.

Probe Dimensions:

1007 type. 2-3/16" x 2-3/16" x 1-7/8" high.

Power Requirements:

117 volts ±10%, 60 Hz., 7 watts.

Probe Mounting:

Four 6-32 mounting screws, on 7/8" centers, two tapped into each side of the probe. Since the probe assumes the potential of the unknown, it must be insulated from ground.

Output:

An output connector is provided for external recording or control.

Size and Weight:

8½" high x 8½" wide x 13" deep. A standard half rack package. 15 lbs.

Options:

Several meter options are available with "--2" supplied as standard:

"--1" 2% center zero with 1% multiplier resistors.
"--2" 2% L. H. zero with 1% multiplier resistors.
"--4" 0.5% taut band, L. H. zero with mirrored scale and 0.1% multiplier resistors.

* These parameters are specified at 1/32" probe-to-surface spacing at constant temperature and relative humidity.

C. MODEL 148 ISOPROBE® ELECTROSTATIC FIELDMETER

Applications:

The Model 148 provides an accurate, non-contacting method for determination of high D.C. potentials as well as general purpose electrostatic field determinations. Its low voltage operation (15 volts max. at probe) makes it especially suitable for work in hazardous environments. Some typical and potential applications include:

- Charge Accumulation Monitoring and Control
- Safety Monitoring Near Radioactive Sources or in Explosive Atmospheres
- Monitoring Van de Graff or Other High Voltage Generators
- Atmospheric Electricity Measurements
- High Voltage D.C. Transmission Terminal Measurements

Range:

0 to 10,000 volts/cm. Meter ranges of 100, 200, 500, 1000, 2000, 5000, and 10000 volts/cm full scale positive or negative.

Sensitivity:*

1 volt/cm.

Static Accuracy:*

2% or better at output.

Drift:*

Less than 5 volts/cm per hour, non-cumulative after 30 minute warm-up.

Noise:*

Less than 1 volt/cm Rms. Less than 5 volts/cm peak-to-peak

Speed-of-Response:

Less than 100 msec., 10% to 90%.

Integrating Capacitor:

Provision for mounting an external integrating capacitor is provided. 0.033μf supplied internally.

Safety:

A maximum of 15 volts and $<1 \times 10^{-6}$ joule is available at the probe to minimize spark hazards and provide for personnel safety.

Power Requirements:

117 volts ±10%, 60 Hz., 7 watts.

Probe Dimensions:

1007 type. 2-3/16" x 2-3/16" x 1-7/8" high.

Probe Mounting:

Four 6-32 machine screws, on 7/8" centers, two tapped into each side of the probe are provided.

Output:

An output connector is provided for external recording or control. Output signal is -1 volt per KV/cm.

Size and Weight:

5 3/4" high x 9½" wide x 13" deep. A standard half rack package, 15 lbs.

Options:

Two meter options are available on the Model 148:
"--1" 2% center zero with 1% multiplier resistors.
"--2" (standard) 2% L. H. zero with 1% multiplier resistors.

The Model 146 offers an additional option:
"--4" 0.5% taut band, L. H. zero with mirrored scale and 0.1% multiplier resistors.

These instruments specified in an uncontaminated atmosphere at constant temperature and relative humidity.

D. Available Probes:

Tabulated below are the probe types normally supplied with each of these instruments. Also tabulated are the equivalent gas purged probes.

NOTE:

Any standard probe may be converted in the field to a gas purged probe by the purchase of a gas purged probe kit Model 1007 GPK available from the factory for $75.00 FOB Middleport.

MODEL NUMBER	STANDARD PROBE	GAS PURGED PROBE
146 147 148	1007 A 1007 B 1007 C	1007 AG 1007 BG 1007 CG

Section 2

INSTALLATION

A. Probe Type - 1007A:

The probe is supplied with a gradient plate, (Models [illegible] and 148 only) Part No. 1007/43 which is fastened to t[illegible] bottom of the probe by means of four 4-40 x 3/16" flat head mounting screws supplied with the instrument. This plate is for fieldmeter (gradient) measurements only ar[illegible] must be removed when operating in the voltmeter mode.

1. Voltmeter Mode: (Models 146 and 147 only)

The probe must be mounted in close proximity to the surface area whose potential is to be measured. For high accuracy work, the separation between the surface and the probe should not exceed 1/8". For less critical measurements, separations up to ½" are permissible.

NOTE: The overall system bandwidth is a function of overall system gain. In the voltmeter mode, the gain is an inverse function of the probe-to-surface separation. Consequently, excessive probe-to-surface separations will result in:

1. Poor speed-of-response.
2. Increased noise.

2. Fieldmeter Mode: (Models 146 and 148 only)

Probe mounting requirements for electrostatic field determinations will vary somewhat with the nature of the desired measurement. In general, it will be best to mount the probe as near as possible to the surface to be monitored - so long as the input signal to the instrument remains less than 10KV/cm.

CAUTION: When used in the FIELDMETER (gradient) MODE, the gradient plate, (Part No. 1007/43) must be installed at the base of the 1007A probe. See figure 1007C/22A.

B. Mounting Screws & Insulation of Probe:

Four 4-40 binding head machine screws are provided for convenience in mounting the probe by means of the top cover. The top cover must be insulated from ground in the voltmeter mode. In the fieldmeter mode the cover

is at ground potential and must be insulated from the bottom plate.

CAUTION: The probe bottom plate must not be shorted to ground.

C. Grounding System:

The instrument chassis is normally grounded when connected to the power line. Potentials and gradients are measured with respect to ground. It is important that any "grounded" portions of the system under test not be physically connected to the chassis of the instrument.

D. Output Circuitry:

The rear panel output connector, J-102, supplies an output voltage which is a 1:1 replica of the unknown voltage in the voltmeter mode and -1V:1KV/cm ratio in the fieldmeter mode.

NOTE: The output polarity is inverted with respect to the input signal in the fieldmeter (gradient) mode.

This signal may be utilized to drive a recorder or other device whose input impedance is 1000 ohms or greater. As the equivalent output impedance is a fraction of an ohm, the output loading effect is negligible.

The output connections are:

Pin	Function
A	Signal
B	Ground

A mating connector is supplied with the instrument.

Section 3

OPERATION

The probe should be mounted in proximity to the surface under measurement in accordance with the preceding installation instructions.

A. Mode Switch: (Model 146 only)

Set the Mode Switch to VOLTS for voltmeter operation or to KV/cm for fieldmeter operation.

B. On-Off Switch:

Power is supplied to the instrument by connecting the power line cord to a source of 117 volts 60Hz. AC and pushing the ON-OFF Switch in until the pilot light is lighted. The instrument is turned off by pulling the switch outward.

C. Meter Range Switch & Polarity Switch:

Set the meter range switch to a suitable range and the meter polarity switch to the correct polarity for the anticipated unknown potential or potential gradient. The meter may be switched out of the output circuit by switching the meter range switch to the OFF position.

D. Zero Control:

The proper use of the instrument's zero control necessitates a thorough comprehension of instrument limitations which in turn influence the instrument's "zero". Please consider the following:

1. Importance of Stable Medium:

It can be demonstrated that any "contamination" present in the probe or in the vicinity of the measurement has an adverse effect on performance which is exhibited as a D.C. offset that usually drifts with time. "Contamination", in this sense, refers to any time varying change in contents of the local environment of the probe and surface under measurement. Included are changes in the constituent gases of the atmosphere as well as aerosols and airborne particles.

The nature of this contamination effect is easily understood in the case of non-conducting solids or liquids which might trap electrostatic charges on a sensitive surface. Less obvious is the influence of gaseous atmospheric constituents which "contaminate" by altering the contact potentials between critical surfaces.

2. Probe Cleanliness:

Where accurate and/or low level measurements are called for, and drift must be avoided, extreme cleanliness and attention to airborne contaminants is vital.

All surfaces involved in measurement should be scrupulously cleaned by the use of a suitable volatile solvent. (See Appendix I.)

> CAUTION: DO NOT USE ANY ABRASIVE CLEANERS ON THE THIN GOLD PLATED ELECTRODES OR THE SURFACE WILL BE DESTROYED.

3. Gas Purging:

A distinct aid in maintaining a clean environment in which to use the probe is a gas purge kit available for the Model 1007 series probes. This kit consists of a low volume, long life air pump which is connected to a filter capable of both mechanical and chemical air filtration. The necessary tubing and additional fittings are included with the kit which is available from the factory in the event it was not ordered with the instrument.

This kit is particularly recommended in the event that the probe is to be used in a highly contaminated environment.

The pump is fully capable of operation on a 24 hour per day basis, thus keeping the probe ready for immediate use.

4. Reference Electrode/Dust Cover:

A reference electrode/dust cover (Monroe Electronics Part No. 1007/22H) is supplied with each probe. This part consists of a gold plated surface mounted on rubber feet, equipped with a ground lead (to attach to the instrument front panel) and an insulating upper structure to act as a dust cover and insulator between the probe

and the reference electrode.

CAUTION: To avoid unnecessary contamination, store the probe in this holder when not in use.

5. Zero Adjustment: - Gold Reference:

The instrument zero is established by grounding the reference electrode to the instrument front panel via the GRD jack provided. The probe is then mounted in the form fitting insulated mount provided.

If the probe and electrodes are clean and stable, a zero field and zero contact potential condition exists between the surface and the probe.

The instrument ZERO control can now be adjusted for zero output as indicated on the front panel meter or extreme indicator.

6. Zero Adjustment: - Arbitrary Reference:

The above procedure is recommended to establish a zero field environment for zeroing the instrument in the gradient mode (Models 146 and 148 only).

It is quite possible that the user may wish to observe small potential changes with reference to an electrode which is not gold.

The instrument zero range is approximately ±2.5 volts thus permitting any arbitrary voltage zero within this range.

[illegible] only to bring the desired reference electrode in close proximity to the probe as described in section 2-A-1 and adjust the ZERO control as desired.

CAUTION: The bottom plate of the probe must never make physical contact with the surface-under-test.

E. Gain Control:

This control determines (a) the static accuracy and (b) the transient response of the instrument. If it is set too low the static error will be excessive and the speed-of-response will be sluggish. If the setting is too high, the transient response may be oscillatory or the instrument may even display a sustained oscillation.

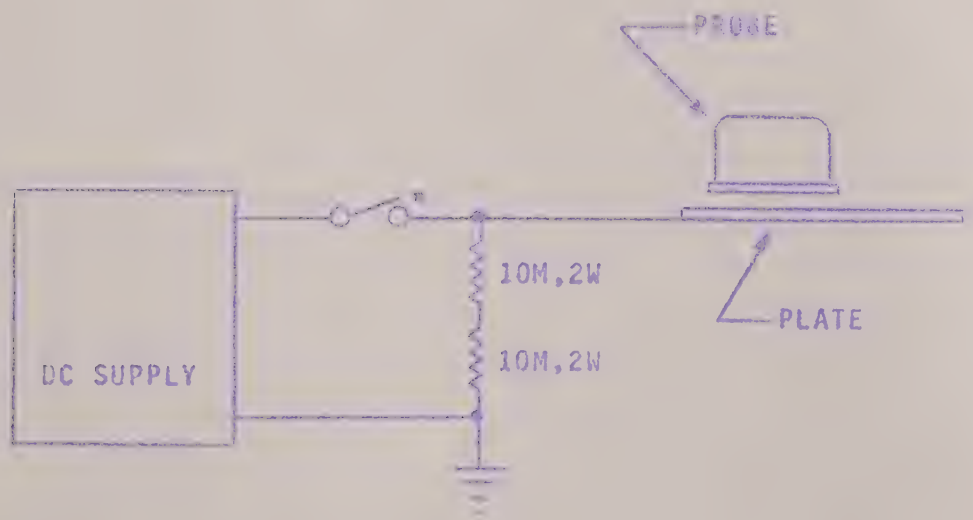
The GAIN control setting, once optimized, may be left undisturbed in the case of the Model 145 or the Model 146 operating in the fieldmeter mode.

In the case of the Model 147 or the Model 146 in the voltmeter mode, the optimum GAIN control setting is a function of probe-to-surface spacing. Decreasing the probe-to-surface spacing has the same influence as increasing the GAIN control. The GAIN control should, therefore, be readjusted whenever the probe-to-surface spacing is altered if optimum speed-of-response is desired.

In the event the front panel meter is the sole indicator of instrument output, the normal static error is very small and speed-of-response is non-critical. For 0.005" probe-to-surface spacing, a half-way setting of the GAIN control will suffice.

In the event a high speed recorder is connected to the output, it may be desirable to optimize the transient response of the instrument. This procedure is as follows:

1. Connect a D.C. supply through a switch to a plate at the same probe-to-surface spacing to be utilized (preferably the same surface if practicable) as shown:



*Switch with low contact bounce - preferably H. V. Reed Relay Contact.

2. Connect the OUTPUT to a recorder or scope.

3. While alternately opening and closing the switch, observe the instrument output and adjust for fastest speed-of-response with minimum overshoot in step response.

Once properly adjusted, the GAIN control should require no further attention unless the probe-to-[illegible] is altered.

A second method to adjust the transient response is to use a square wave generator with a repetition rate of 5 Hz. or less in place of the D.C. supply and switch in the previous diagram.

The static follow-up error* of a carefully zeroed and adjusted instrument is typically less than .05% throughout its range.

*Difference in D.C. potential between the unknown and the probe.

Section 4

THEORY

Whether the instrument functions as an electrostatic voltmeter or an electrostatic fieldmeter, the major blocks of the two systems are identical except for differences in the feedback technique.

The following is, therefore, a block-to-block description of the components of the system followed by a description of how the blocks utilize feedback to achieve the desired performance.

A. Type 1007 Probe:

Please refer to Schematic 1007/12 at the rear of the manual.

The transducer is shown on the left side of the schematic. It includes a mechanical driver which vibrates the one inch circular sensitive electrode along an axis perpendicular to its surface.

This sensitive electrode has induced upon it a voltage directly proportional to both the ambient D.C. electric field intensity and the displacement imparted by the mechanical driver.

In order to achieve maximum available signal voltage from the sensitive electrode, the undesired distributed capacitance to surfaces other than the unknown or intended feedback surface are minimized by use of a special Voltage Follower Preamplifier (Model 410), which also serves to minimize capacitance loading of all the following circuitry.

This preamplifier exhibits an input capacitance which is small in comparison to the "source" capacitance of the sensitive electrode. It also exhibits an extremely high input resistance - in the order of thousands of megohms. Its gain is very nearly unity at the operating frequency ($A \approx +0.999$).

Additionally, because of its low output impedance and large phase margin, it is capable of driving a large capacitive load with stability. This characteristic insures a capability for driving a long interconnecting cable thus permitting large separation between the probe and its indicator.

Notice the direct connection from the sensitive electrode to the ZERO control via R-1 and R-5. The ZERO control provides an adjustable source of D.C. which permits the nulling of any residual field under conditions when the

indicator should read zero. This permits effective compensation for the existence of any residual contact potential or other minor residual charge.

The coupling capacitor C-1 isolates the preamplifier bias from the D.C. circuitry of the sensitive electrode.

Capacitor C-5 and resistor R-15 eliminate the D.C. component of the preamplifier output from the driven shield signal.

B. Current Limiter:

Please refer to the main schematic (Model 146/1, 147/1, or 148/1 as appropriate) at the rear of the manual. Notice that transistor Q-101, shown in the lower left hand section of this schematic, functions in association with R-102, CR-101, CR-102 and R-101 as a normally saturated constant current source. Q-101 is capable of supplying a maximum of approximately 10 milliamperes in its limiting condition. The normal current requirement of the preamplifier, however, is significantly less than this value with the result that Q-101 is normally saturated and approximately 14.8 volts is available for preamp power.

Additionally, with Q-101 functioning the capacitance of the probe source is reduced to less than 0.001 μFD thus permitting less than one microjoule of available spark energy.

C. Oscillator Model 3007:

The oscillator assembly A-4, provides the driving signal for the electromechanical transducer in the probe assembly as well as providing a reference signal for the Model 370A-2 Demodulator. It contains an amplitude stabilized oscillator utilizing a Monroe Electronics Model 408 Operational Amplifier with its associated "bridged T" feedback network. The oscillator output feeds transformer, T-1, which feeds the probe's electromechanical transducer. The output also furnishes the reference input to the demodulator assembly A-3 through T-3.

Transformer T-2 in association with lamp assembly I-1 and variable resistor R-2 stabilizes the amplitude of the oscillator by functioning as an A.C. Rms. voltage sensitive positive feedback path.

D. Amplifier Model 3008:

The amplifier assembly A-5 is a variable gain A.C. amplifier used to boost the signal provided by the probe

It consists of a Monroe Electronics Model 401 Operational Amplifier, the front panel GAIN control, R-108 and a phase control, R-3 mounted on the circuit board. The amplifier overload transients are limited by CR-1 and CR-2. The A.C. output signal from the secondary of transformer T-1 is fed to the Demodulator Assembly, A-3.

E. Demodulator Model 370A-2:

The Demodulator Assembly, A-3 detects the phase angle between the reference and signal voltages and thereby determines the polarity of the unknown signal.

The constant reference voltage from the oscillator feeds pins 4 and 7 of the module and generates a constant D.C. voltage across C-3 and, therefore, between J-1 and J-2. This voltage serves to set or check the reference voltage amplitude. The signal voltage should normally be either in phase or in phase opposition relative to the reference voltage.

If the signal voltage is zero, J-1 and J-2 should be equal in magnitude and opposite in polarity relative to ground. The arm of the integrator ZERO control, R-10 should, therefore, be at a balance point permitting no current to flow to ground in the event of a short circuit to ground.

If we assume a signal of one volt peak amplitude which is in phase with the reference voltage feeding pin 4 and in phase opposition to the reference voltage feeding pin 7, then the D.C. potential of J-1 will increase one volt while that of J-2 will decrease one volt. A short circuit current derived from the voltage of J-1 via R-9 of approximately 10 microamperes will flow. Similarly, a current of 10 microamperes derived from J-2 via R-11 will flow providing a total of 20 microamperes of short circuit current.

Should the phase of the signal voltage be reversed, the same short circuit current will flow but in the opposite direction.

The output from the Demodulator can then be a current whose magnitude is linearly related to the peak signal amplitude and whose direction reverses with phase reversal

NOTE: The Demodulator board, A-3 has provision to apply a portion of the 340 Hz. oscillator signal through the R Balance and C Balance controls to buck out the 340 Hz. oscillator signal at the input of the integrator, A-2.

F. Integrator Model 353A-4:

The demodulated output of the Phase Sensitive Detector is integrated by the operational amplifier, A-2 with its associated integrating capacitor C-103. Provision is made via jacks J-103 and J-104 to reduce the bandwidth of the integrator by inserting an external capacitor thereby reducing noise at a sacrifice in speed-of-response.

G. Closing the Loop:

1. Voltmeter Mode:

In the voltmeter mode, the probe bottom plate is connected to circuit common while the integrator output is grounded.

This causes the system to function such that the probe bottom plate (and probe frame) is driven to a voltage precisely equal to the unknown under measurement thus creating a null in the incident D.C. electrostatic field.

As the open loop gain of the system is very high (approximately 10^5), the probe frame is driven typically to within less than 0.05% of the potential of the unknown.

The OUTPUT (and thus meter indication) is, therefore, developed between circuit common and ground.

2. Fieldmeter Mode:

In the fieldmeter mode, the circuit common is grounded and the system output is the integrator output with respect to ground (circuit common).

The gradient plate must be attached to the bottom plate of the probe in this case.

The aperture size of the gradient plate is carefully chosen such that a fraction of the output voltage (whose polarity is opposite to the unknown field under measurement) when fedback to the gradient plate (bottom plate) creates a null in the net field incident upon the probe's sensitive vibrating electrode.

The GRADIENT CAL pot controls the fractional voltage feedback with the result that the system can be calibrated to read field intensity in a straightforward manner.

H. Output and Meter Circuit:

The 50μ ampere, 100 MV meter is connected through appropriate multiplier resistors between the power supply common and the output of the integrator.

The instrument OUTPUT is a signal at pin A relative to instrument chassis ground, pin B.

In the voltmeter mode, the OUTPUT is precisely equal to the input and of the same polarity.

In the fieldmeter (gradient) mode, the OUTPUT is of opposite sign to the input with a scale factor of one volt equal to one kilovolt per centimeter.

I. Power Supply Model 384A:

The Model 384A provides plus and minus 15 volt power to all of the electronics in the system including the 1007 Probe. Please refer to the P.C. card schematic 384A/1. The plus and minus 15 volt supplies are identical in design with the following exceptions:

1. The plus supply uses CR-4 as a voltage reference element, while the reference for the minus supply is the regulated output of the plus supply.

2. The polarity of the semiconductors in the minus supply is reversed to facilitate the negative output.

Therefore, the description of the plus supply will also apply to the minus supply with the above exceptions.

Transformer, T-101 provides 40 volt A.C. CT to the rectifier/filter consisting of CR-1, CR-2 and C-1. This supplies all unregulated power to the +15 volt regulator.

CR-4 is the reference zener for the positive supply.

Q-6 and Q-3 function as a differential amplifier which compares the reference voltage to the divided down output voltage.

Q-5 functions as a constant voltage supply for the collector of Q-6 while passing the current of Q-6 with essentially unity current gain to Q-2, which, with CR-3, R-5 and R-4, functions as a unity current gain inverter such that the signal currents of Q-2 and Q-8 add into the load of the base of Q-7, the input pass transistor.

The above circuitry, therefore, constitutes a high gain comparison amplifier displaying excellent immunity to temperature and supply voltage changes.

Q-1's collector feeds the base of Q-4 which is Darlington connected to Q-3, the power pass transistor.

Q-1 functions as the current limiter by sensing the load current across R-1 and R-2 and shunting R-3 when the current exceeds the preset level.

Section 5

INTERNAL ADJUSTMENT PROCEDURES

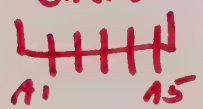
A. General:

1. Normal operating procedure requires the use of only the front panel controls as described in the operating procedure.

2. All internal adjustment control settings are stable both as a function of time and temperature, therefore, frequent adjustment is neither necessary nor recommended.

3. To reduce the interaction effects of the adjustment, all adjustments must be made in the order given.

PC CARDS



4. When facing the rear of the instrument, the P.C. (printed circuit) cards A-1 through A-5 and their respective controls are made accessable by removing the P.C. card cover panel. The cards are physically arranged in numerical order with A-1 on the left and A-5 on the right. All adjustment controls are of the multi-turn screwdriver type.

5. All adjustments are made with the instrument functioning in the millivolt mode with the probe positioned 1/32" above a grounded surface except as noted for each test.

B. Specific:

1. Reference Amplitude Control:

The reference amplitude control is the control mounted toward the bottom of the Model 3007 Oscillator (p.c. board A-4). The reference amplitude is measured at the two test jacks mounted on the Model 370A-2 Demodulator (p.c. board A-3).

a. Set the front panel gain control to approximately ½ gain.

b. While monitoring the reference voltage adjust the reference amplitude control to produce 10.0 V ±5% at the test jack.

2. Noise Adjustments:

The noise adjustments are located toward the bottom of the Model 370A-2 Demodulator (p.c. board A-3).

a. Connect an oscilloscope to the output terminals.

b. Adjust the noise controls to produce less than 1.0 mV P-P 340 Hz. noise as observed on the oscilloscope.

3. Integrator Zero Adjustment:

The integrator zero control is located toward the top of the Model 370-2 Demodulator (A-3). It may be adjusted as follows:

a. With the probe looking at a grounded surface, zero the instrument using the front panel zero control.

b. It may be noted that as the gain control is varied over its range (from "zero" or full counterclockwise, to just below the point of system oscillation), the meter (and output) indication changes.

To correctly set the integrator zero, note the meter reading at a high gain setting (non-oscillation). Reduce the gain to a low setting, adjust the integrator zero to the high gain reading. Continue the process so that the shift in instrument zero with changes in gain control settings is minimum.

4. Null Balance Adjustment:

The capacitive coupling between the sensitive electrode and various other probe parts can produce a false signal voltage which should be bucked out for optimum instrument operation. The null balance adjustment is provided specifically for this purpose. It is located toward the top of the Model 3007 Oscillator Board (A-4).

a. Observe the difference in meter indications as the probe is moved from a close spacing to a larger spacing (approximately 1/8" to ½") while looking at a test surface.*

b. Adjust the null balance control to produce minimum change under above conditions (a).

*It is assumed that the large spacing does not allow the "field of vision" of the probe to see stray fields.

5. Field Meter Calibration: (Models 140 and 148 only)

The field meter calibration control is positioned on the system main switch just behind the front panel. It is made accessible by removing the top chassis cover.

a. Switch the instrument to the field meter mode and attach the gradient plate to the probe.

b. Position the probe at some distance "d" above a grounded test surface.

c. Adjust the front panel zero control to 0.0 as indicated on the meter (or output).

d. Apply a voltage "V" to the test surface.

e. Adjust the fieldmeter calibration control to produce a gradient E (meter reading) such that:

V in kilovolts $\quad\quad$ λ in centimeters^{-1}

E in kilovolts/cm $\quad\quad$ d in centimeters

$$E = V\lambda \qquad\qquad \lambda = 1/d$$

Section 6

MAINTENANCE

Normal maintenance for this instrument should be limited to periodic cleaning and adjustments as described in the preceding section.

In the event of a catastrophic failure, it will more than likely occur in a plug-in module.

Replacement modules are available at the factory. Factory repair of defective modules is recommended as many components employed in these modules are selected.

Listed as follows are replacement plug-in modules with their current and repair prices.

MODELS 146, 147 & 148 PARTS AND ACCESSORIES

The following is a complete list of Model 146, 147 or 148 interchangeable replacement parts and modules. The 90 day repair price, after the warranty period is 1/2 of the indicated part price for items 2 through 7. Item 1 is repaired on a time and material basis only.

Item No.	Model No.	Description	Price
1A	1007A	Probe	$ 295.00
1B	1007AG	Gas Purged Probe	370.00
2	353B-4C	Operational Amplifier	71.00
3	370A-2	Phase Sensitive Detector	55.00
4	384A	Power Supply	83.00
5	3007A	Oscillator	174.00
6	3008	Amplifier	121.00
7	302	Extension Board Circuit	14.80

All prices are FOB factory, Middleport, New York

Prices and specifications are subject to change without notice.

SLOW FUSE - Access to the power line fuse (3AG 1/8 amp) is achieved by pulling the ON-OFF switch knob outward and turning it counterclockwise.

NOTE:

IN THE EVENT OF DIFFICULTY, PLEASE FEEL FREE TO CONTACT THE FACTORY.

MONROE ELECTRONICS, INC.
Repair Price Schedule
Major Instruments

Effective: March 15, 1969

It is the policy of Monroe Electronics, Inc. to provide for the repair of all its standard products. Major instruments may be returned for repair regardless of age or condition.

The following price schedule, based on instrument age, is designed to simplify cost estimating for repair jobs. It reflects the cost of maintaining the technical skills required to repair obsolete instruments no longer manufactured or sold as well as the ever increasing costs of parts and labor.

Major Instruments include the entire Electrostatic Product line, all power supplies and calibration equipment, and in general, all other instruments with a purchase price in excess of $500.00.

A. Labor - including small parts replacement:

Instrument Age	Price
Less than 1 year old	free (original warranty)
1 to 3 years old	10% of purchase price
3 to 5 years old	20% of purchase price
5 to 10 years old	50% of purchase price
Greater than 10 years old	75% of purchase price

B. Parts:

1. No extra charge for small part or component replacement.

2. Missing parts (or complete modules) will be charged at established selling price.

3. Parts or components damaged through physical or electrical abuse or misuse will be charged at established selling price.

C. Warranty:

All instruments repaired on a "non-warranty" basis will also be completely tested and recalibrated and returned with a new instrument warranty -- one full year from date of repair. Instrument age, however, will always be determined from date of original purchase.

APPENDIX I

MODEL 1007 PROBE CLEANING PROCEDURE

1. Turn off power.

2. Remove gradient plate (Part No. 1007/43) if used. (Not supplied with Model 147) See figure 1007C/22A.

3. Clean center one inch circular gold plated electrode with S-108 "Freon" TF Degreaser or other suitable solvent which evaporates and leaves no residue.

CAUTION:

1. DO NOT IMMERSE TRANSDUCER IN SOLVENT.

2. DO NOT DISASSEMBLE PROBE.

In the event a defect is indicated that is not related to cleaning, return the probe to the factory for repair.

Contact the factory for instructions prior to shipping.

APPENDIX II

INSTALLATION INSTRUCTIONS FOR GAS PURGE KIT

1. Remove the 5-32 binder head screw from cover of Model 1007 Probe. This is located at the top of the unit next to the cable exit.

2. Insert the purge tube (small threaded metal tube) with the nut run up the threaded portion. This will allow the tube to be pointed in the desired direction and then locked in place with the nut.

3. The length of TYGON® plastic tubing supplied with the kit must be cut into two pieces, the length of which will be determined by the relative placement of the air pump, air purifier/flow equalizer, and the probe; the air purifier/flow equalizer being connected between the air pump and the probe.

4. Attach one brass fitting (supplied with kit) to each length of TYGON® tubing.

5. Connect one length of tubing to each end of the air purifier/flow equalizer (via attached fittings).

6. Fit one free end of the plastic tubing over the air pump exhaust (small tube on air pump opposite line cord).

7. Fit the remaining free end of the plastic tubing over the purge tube (attached to probe).

8. Apparatus is now ready for operation.

APPENDIX III

OPERATION INSTRUCTIONS FOR GAS PURGED PROBE

1. Install apparatus as outlined in preceeding page. Mount probe as necessary.

2. Connect air pump to source of 110 volt alternating current (A.C.) only.

3. For maximum air flow, turn adjusting thumbscrew (on top of air pump) clockwise until a rattling noise is heard and then turn counterclockwise ½ turn. DO NOT OPERATE PUMP WITH ADJUSTING THUMBSCREW TURNED DOWN PAST RATTLING NOISE.

4. A positive air pressure is now maintained at the probe.

5. For best results, leave the pump in continuous operation.

6. When the pump is disconnected, cover the sensitive aperture with tape to seal the opening against external contamination, or store in Reference Electrode/Dust Cover.

7. The useful life of the air purifier/flow equalizer will be dependent upon individual conditions and deterioration may be most noticeably observed as gradual degradation in performance of the ISOPROBE® Electrostatic Voltmeter due to contaminants entering the probe through the purging system.

8. Under normal laboratory conditions, replacement is recommended annually.

9. Replacement air purifier/flow equalizer units may be obtained at $7.50 each from Monroe Electronics, Inc.

10. The air pump is guaranteed by the manufacturers. The guarantee may be validated by complying with the terms set forth on the guarantee registration form.

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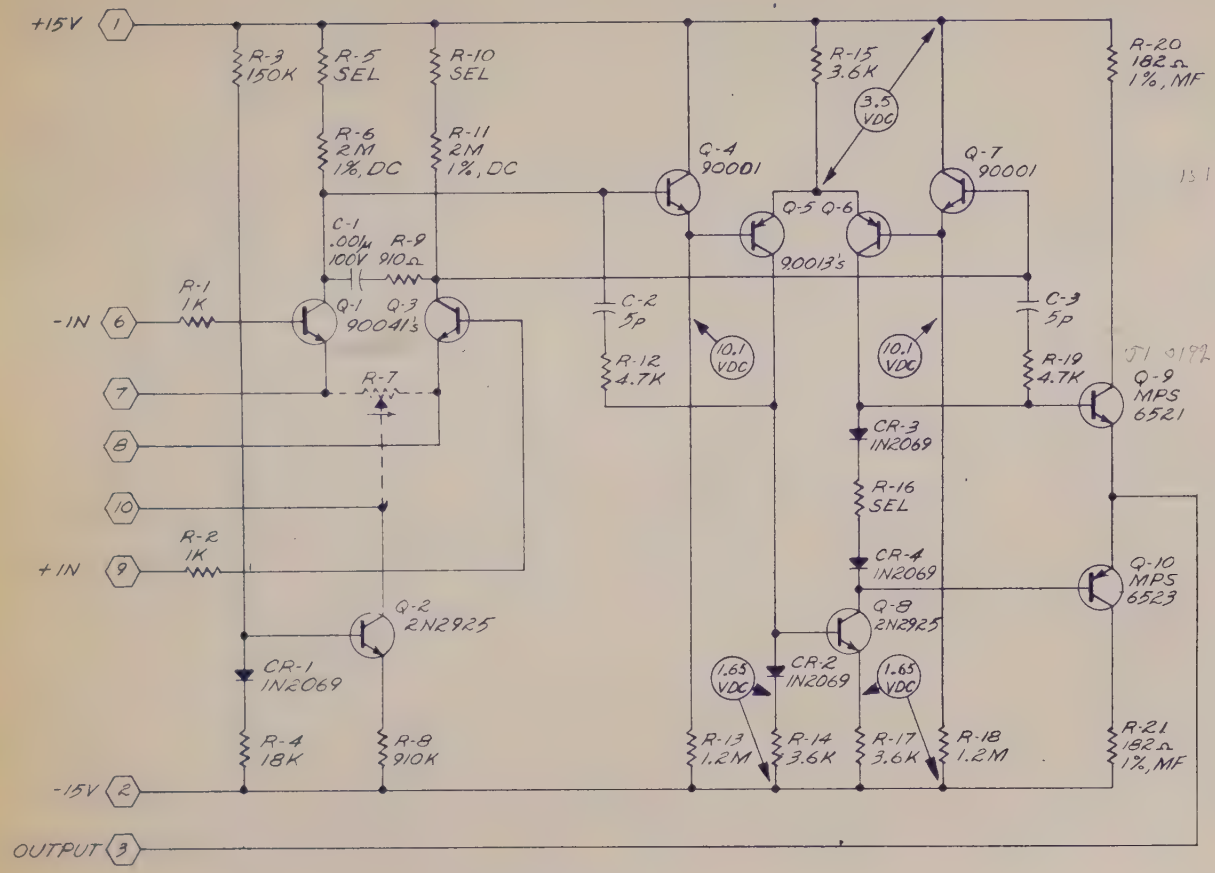

PATENTED

NOTE:
ALL RES. ¼ W, 5% EXECPT AS NOTED.
ALL VOLTAGES DC WITH RESPECT TO CIRCUIT COMMON UNLESS OTHERWISE SPECIFIED. USE 20 KΩ/V METER WITH AMP. OPERATING IN NORMAL CLOSED LOOP CONDITION.

SUPERSEDES 353 & 353A RLD 9-3-68

REVISIONS DATE

RLD 12-6-68

MONROE ELECTRONICS, Inc.
MIDDLEPORT, N. Y

MODEL 353B-4
HI-INPUT Z OP AMP

353B-4/1

353B-4/1

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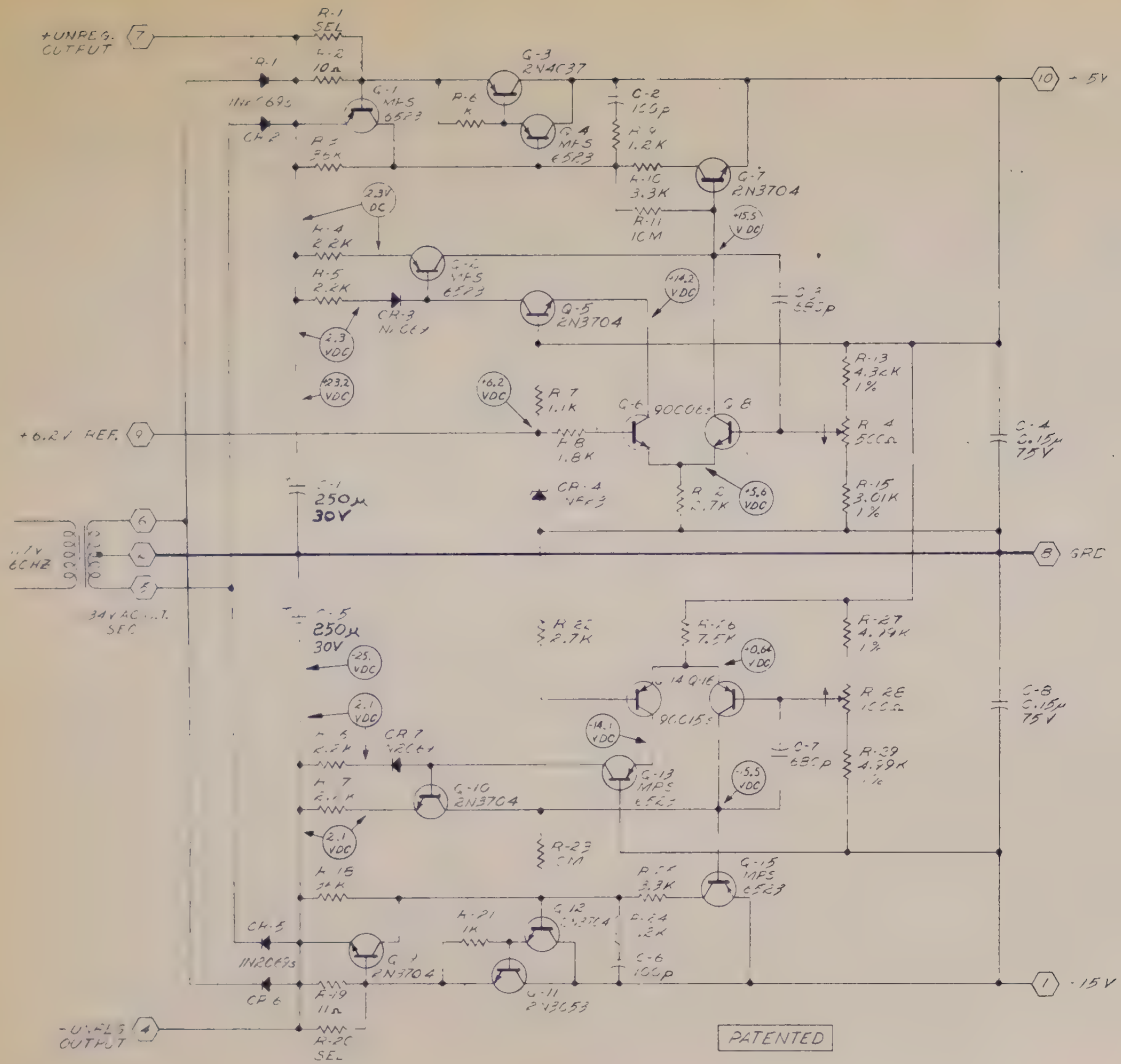


PATENTED

NOTE:
1. ALL RESISTORS ¼W, 5% EXCEPT AS NOTED
2. SEL = RESISTANCE VALUE FACTORY SELECTED
3. ALL VOLTAGES MEASURED WITH 20KΩ/V VOLTMETER, REFERRED TO COMMON UNLESS OTHERWISE INDICATED

MONROE ELECTRONICS, INC.
MIDDLEPORT, N. Y.

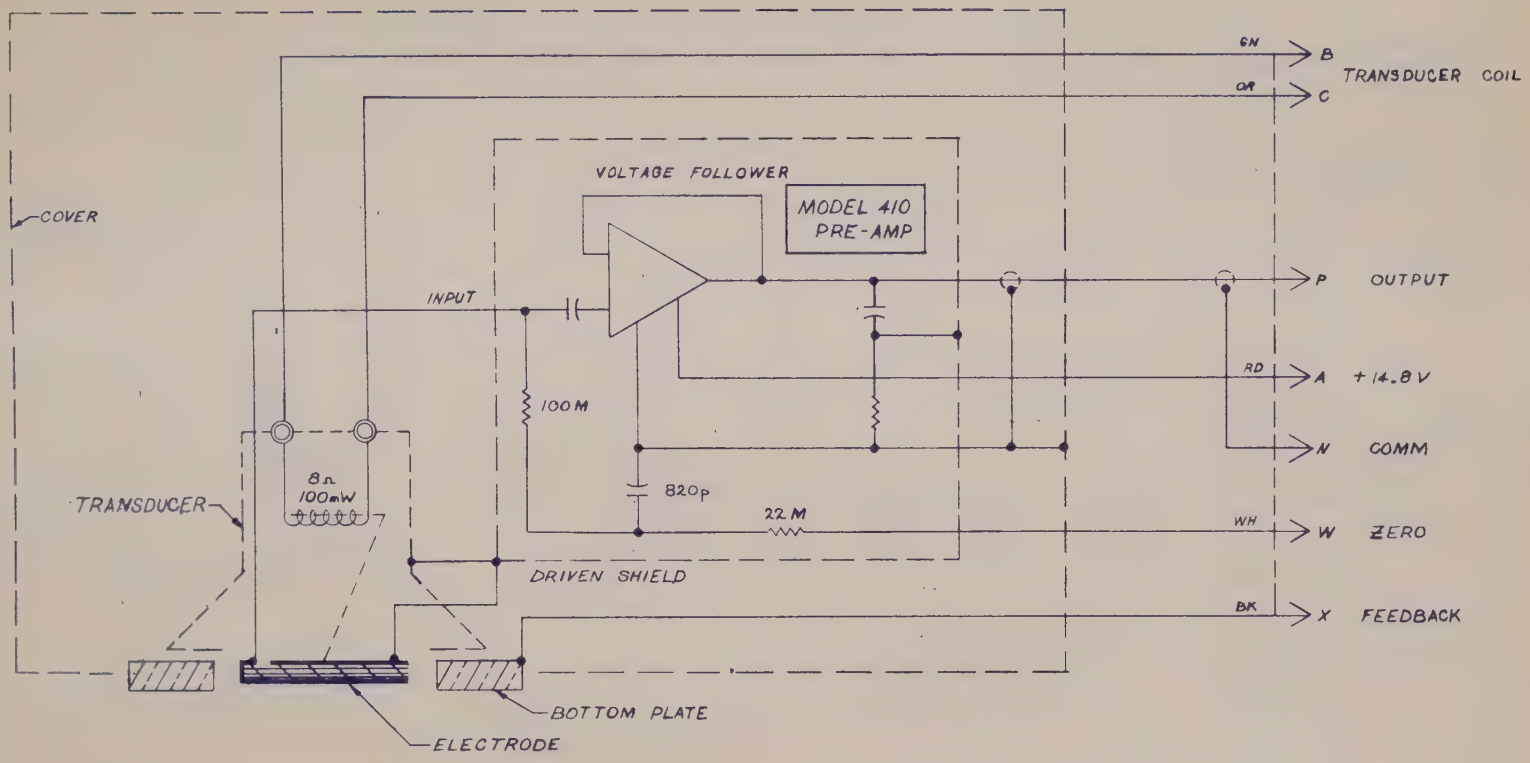
RLD 3-14-68

MODEL 384A
±15V ± 50MA ±0.1%
REG P.S.

384A/1

KEY PIN 3

384A/1

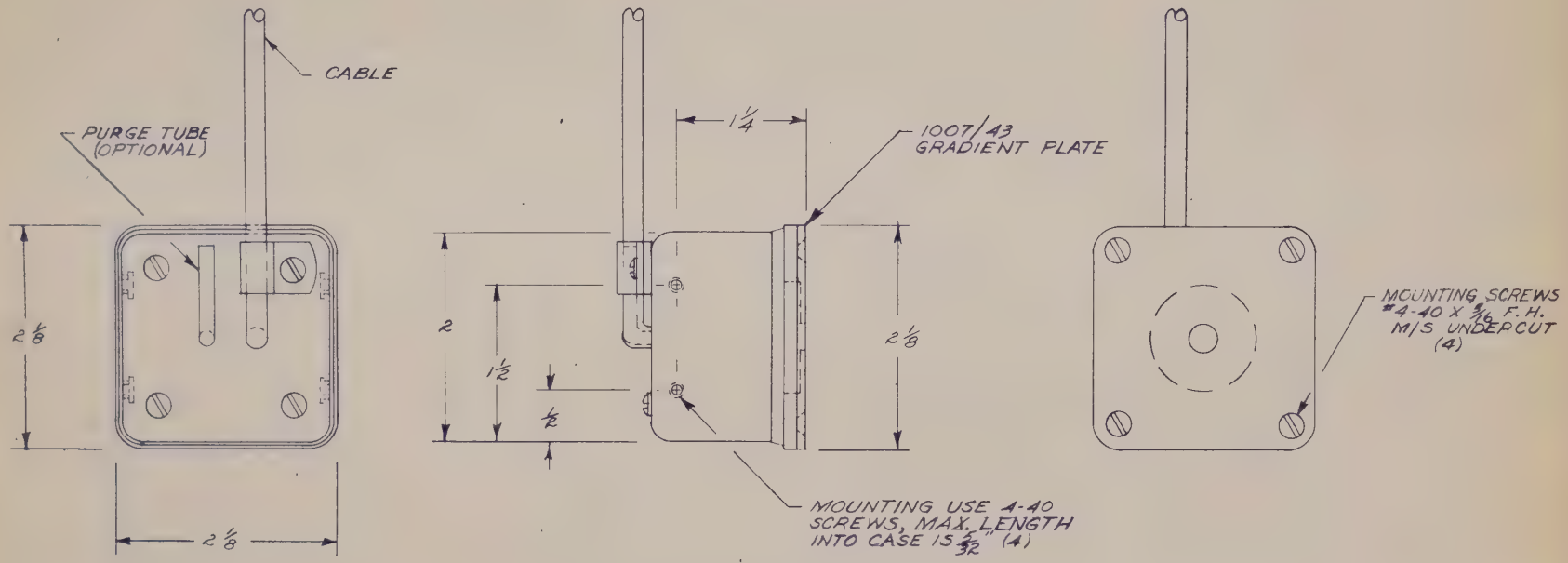


1007/12

		LOC. LET	REVISIONS	DATE
		SCALE	DATE	MONROE ELECTRONICS, Inc. MIDDLEPORT, N. Y.
		DRAWN	B.W.C. 9-27-68	MODEL 1007 VIBRATING CAPACITANCE PROBE
		CH KD		
NEXT ASSEMBLY	NO REQ	APP D		

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1°
MATERIAL

1007/12

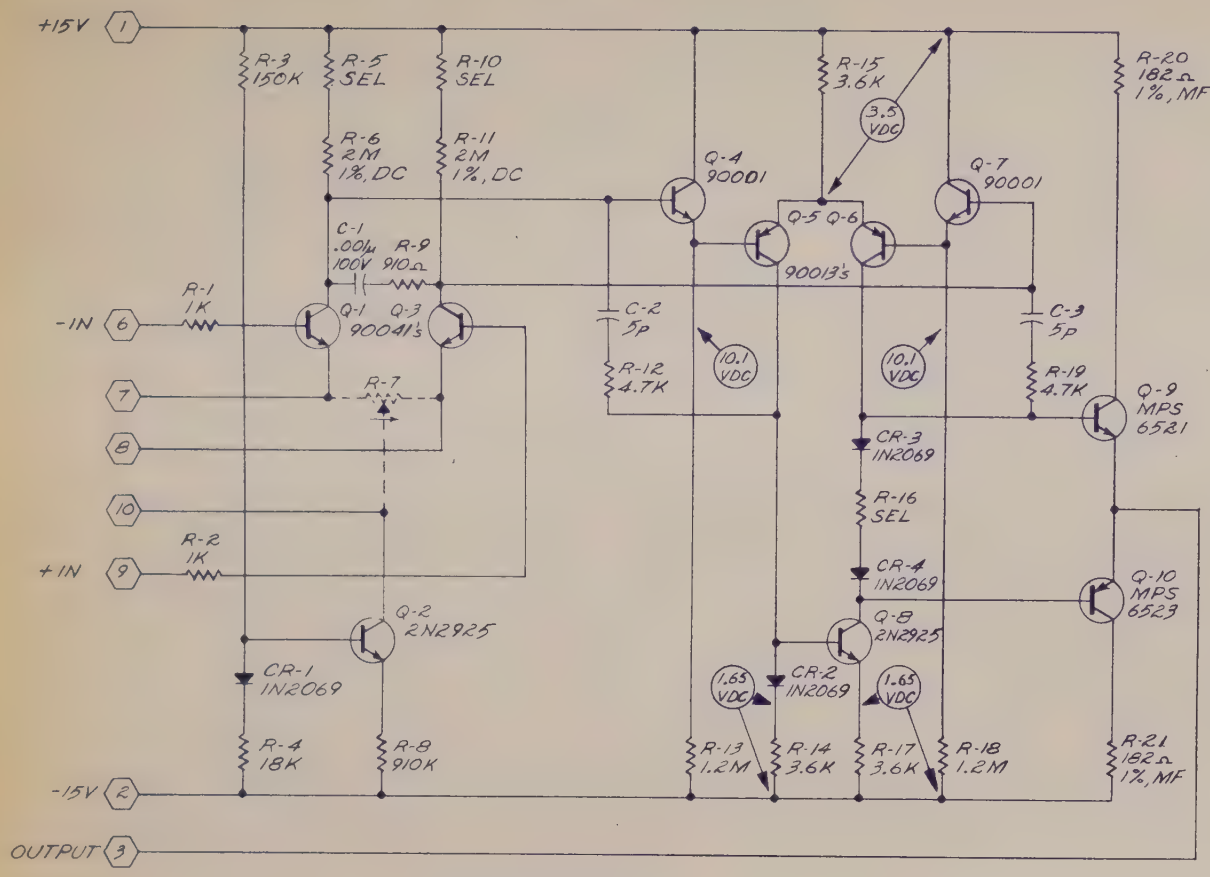


1007/22A

		LOC LET	REVISIONS			DATE
		SCALE	FULL	DATE	ME	MONROE ELECTRONICS, Inc. MIDDLEPORT, N. Y.
		DRAWN	RLD	12-18-67		
		CH KD			MODEL 1007C VIBRATING CAPACITANCE PROBE	
NEXT ASSEMBLY	NO REQ	APP D				

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1-64 ANGULAR ± 1°
MATERIAL

1007C/22A



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PATENTED

NOTE:
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ALL VOLTAGES DC WITH RESPECT TO CIRCUIT COMMON UNLESS OTHERWISE SPECIFIED. USE 20 KΩ/V METER WITH AMP. OPERATING IN NORMAL CLOSED LOOP CONDITION.

KEY 4 & 5

353B-4/1

SUPERSEDES 353 & 353A RLD 9-3-68

REVISIONS | DATE

DRAWN RLD 1-26-68

MONROE ELECTRONICS, Inc.
MIDDLEPORT, N. Y

MODEL 353B-4
HI-INPUT Z OP AMP

353B-4/1

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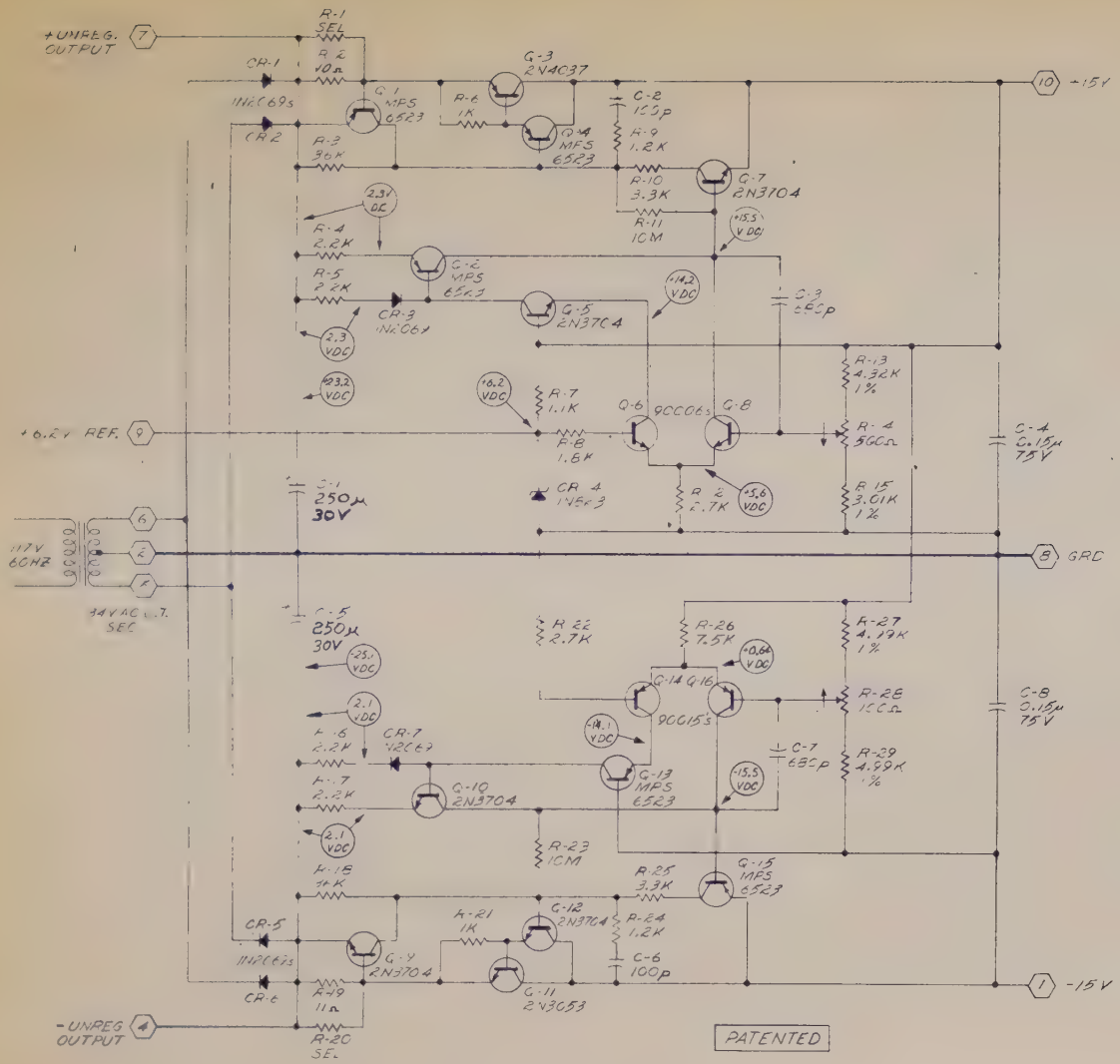


PATENTED

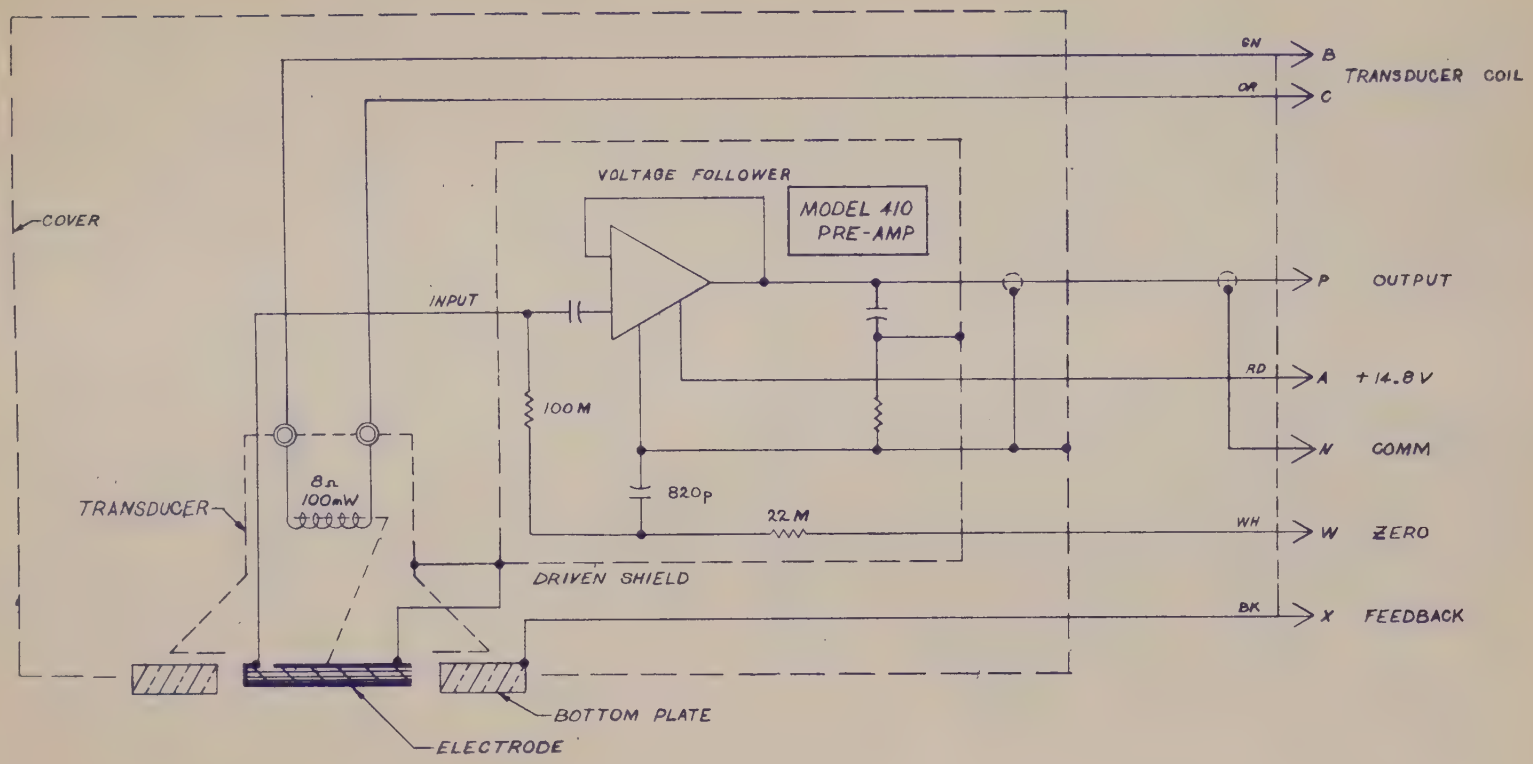
NOTE:
1. ALL RESISTORS ¼W, 5% EXCEPT AS NOTED
2. SEL = RESISTANCE VALUE FACTORY SELECTED
3. ALL VOLTAGES MEASURED WITH 20KΩ/V VOLTMETER, REFERRED TO COMMON UNLESS OTHERWISE INDICATED

MONROE ELECTRONICS, Inc.
MIDDLEPORT, N. Y.
RLD 3-14-68
MODEL 384A
±15V ± 50MA ±0.1%
REG P.S.

384A/1

KEY PIN 3

384A/1

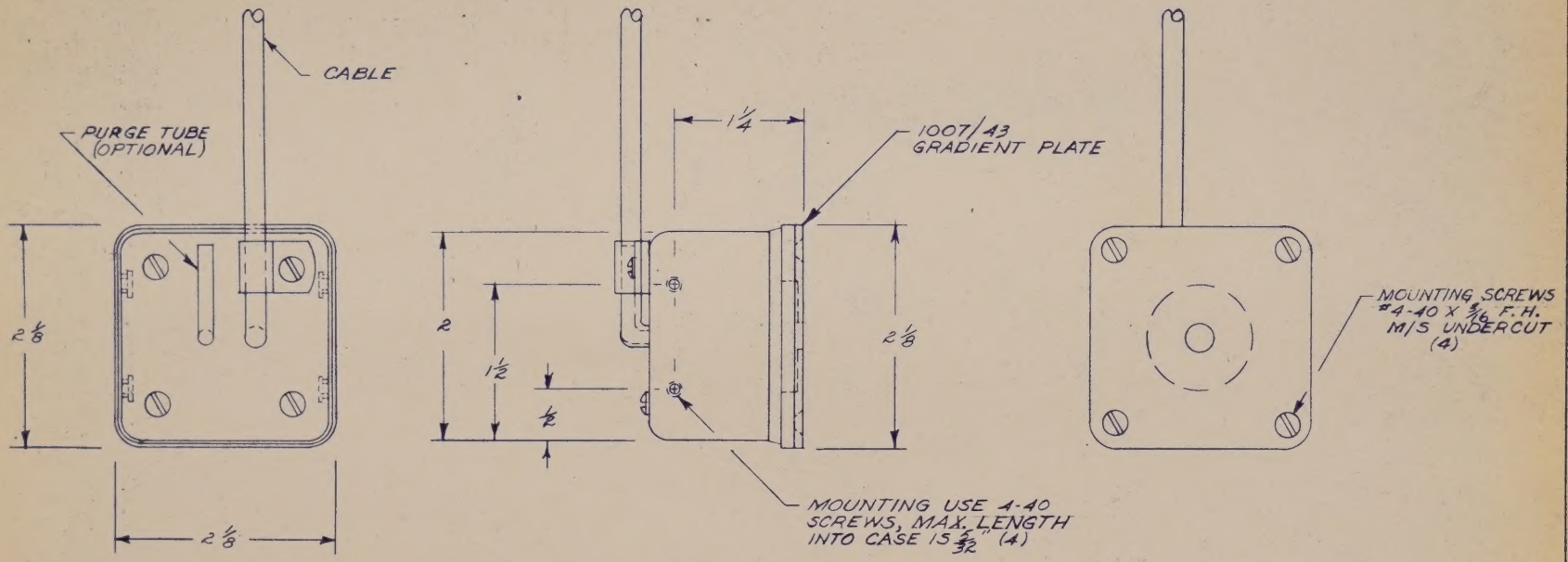


1007/12

		LOC. LET	REVISIONS	DATE
		SCALE	DATE	MONROE ELECTRONICS, Inc. MIDDLEPORT, N. Y.
		DRAWN	B.W.C. 9-27-68	
		CH KD		MODEL 1007 VIBRATING CAPACITANCE PROBE
NEXT ASSEMBLY	NO. REQ	APP'D		

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 15'
MATERIAL

1007/12



1007/22A

		LOC	LET	REVISIONS	DATE
		SCALE	FULL	DATE	
		DRAWN	RLD	12-18-67	
		CH'KD			
NEXT ASSEMBLY	NO. REQ	APP'D			

MONROE ELECTRONICS, Inc.
MIDDLEPORT, N. Y.

MODEL 1007C
VIBRATING CAPACITANCE PROBE

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1°
MATERIAL

1007C/22A

MP MASTER
MA21734